

## CsI Calorimeter for a Compton-Pair Telescope

Completed Technology Project (2017 - 2018)



## Project Introduction

We propose to build and test a hodoscopic CsI(Tl) scintillating-crystal calorimeter for a medium-energy  $\gamma$ -ray Compton and pair telescope. The design and technical approach for this calorimeter relies deeply on heritage from the Fermi LAT CsI Calorimeter, but it dramatically improves the low-energy performance of that design by reading out the scintillation light with silicon photomultipliers (SiPMs), making the technology developed for Fermi applicable in the Compton regime. While such a hodoscopic calorimeter is useful for an entire class of medium-energy  $\gamma$ -ray telescope designs, we propose to build it explicitly to support beam tests and balloon flight of the Proto-ComPair telescope, the development and construction of which was funded in a four-year APRA program beginning in 2015 ("ComPair: Steps to a Medium Energy  $\gamma$ -ray Mission" with PI J. McEnery of GSFC). That award did not include funding for its CsI calorimeter subsystem, and this proposal is intended to cover that gap. ComPair is a MIDEX-class instrument concept to perform a high-sensitivity survey of the  $\gamma$ -ray sky from  $\sim 0.5$  MeV to  $\sim 500$  MeV. ComPair is designed to provide a dramatic increase in sensitivity relative to previous instruments in this energy range (predominantly INTEGRAL/SPI and Compton COMPTEL), with the same transformative sensitivity increase – and corresponding scientific return – that the Fermi Large Area Telescope provided relative to Compton EGRET. To enable transformative science over a broad range of MeV energies and with a wide field of view, ComPair is a combined Compton telescope and pair telescope employing a silicon-strip tracker (for Compton scattering and pair conversion and tracking) and a solid-state CdZnTe calorimeter (for Compton absorption) and CsI calorimeter (for pair calorimetry), surrounded by a plastic scintillator anti-coincidence detector. Under the current proposal, we will complete the detailed design, assembly, and test of the CsI calorimeter for the risk-reduction prototype telescope, Proto-ComPair. We will: 1. Purchase CsI(Tl) crystals, Silicon Photomultipliers (SiPMs), and components for the analog and digital readout of the SiPMs; 2. Assemble and test Crystal Detector Elements (CDEs) from crystals, SiPMs and optical wrap; 3. Assemble and test analog and digital front-end and readout control boards; 4. Fabricate the mechanical structure that supports and contains the CDEs and electronics boards; and 5. Assemble and test the CsI calorimeter, and integrate it with the remainder of the Proto-ComPair subsystems. The PI team for this proposal conceived, designed, developed, assembled, tested, and currently operates the LAT calorimeter and is uniquely qualified to leverage the experience gained from that effort for ComPair.



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## Organizational Responsibility

**Responsible Mission Directorate:**

Science Mission Directorate (SMD)

**Responsible Program:**

Astrophysics Research and Analysis

## Project Management

**Program Director:**

Michael A Garcia

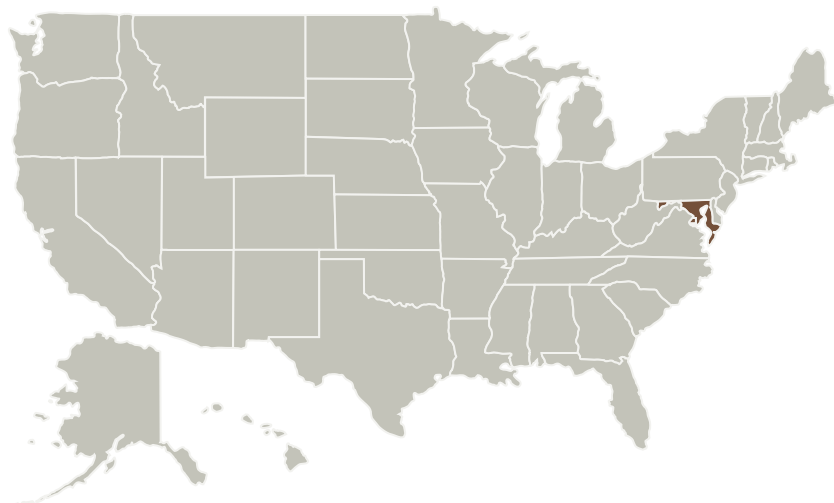
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## Primary U.S. Work Locations and Key Partners



### Primary U.S. Work Locations

District of Columbia

Maryland

## Project Management (cont.)

### Program Manager:

Dominic J Benford

### Principal Investigator:

J Eric Grove

### Co-Investigators:

Jill P Dahlburg  
W Neil Johnson  
Bernard Philips  
Richard S Woolf  
Julie E Mcenery

## Technology Areas

### Primary:

- TX08 Sensors and Instruments
  - └ TX08.1 Remote Sensing Instruments/Sensors
    - └ TX08.1.1 Detectors and Focal Planes

## Target Destination

Outside the Solar System